(12) UK Patent Application (19) GB (11) 2 224 540 (13) A

(43) Date of A publication 09.05.1990

(21) Application No 8825622.7

(22) Date of filing 02.11.1988

(51) INT CL⁴
F01N 1/18, F02B 27/04

(52) UK CL (Edition J)
F1B BFB BF204 BF227 BF240 BF320

(56) Documents cited
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(58) Field of search
UK CL (Edition J) F1B
INT CL⁴ F01N, F02B

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(54) I.c. engine exhaust silencer

(57) The hollow shaft 7 supporting a turbine 8 and fans 9, 10 is adjustably mounted on a shaft 5 rotatable in bearings 6 or mounted for rotation on bushes (12, Fig. 3) carried by a fixed shaft. The silencer casing may contain a plurality of rotors (Fig. 4) and have a plurality of inlet pipes 2.

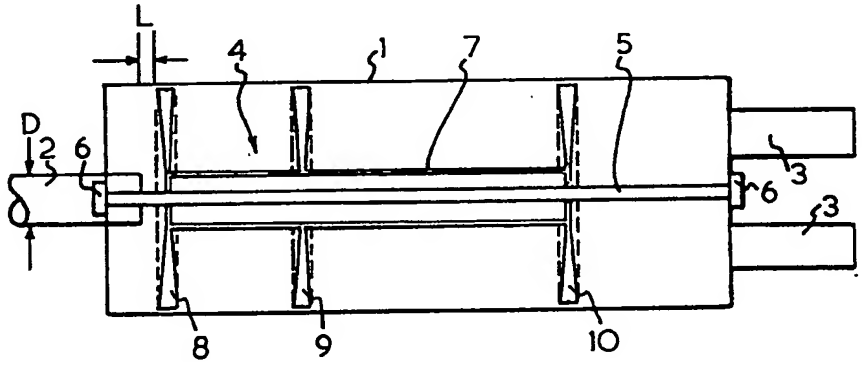

Fig 1.

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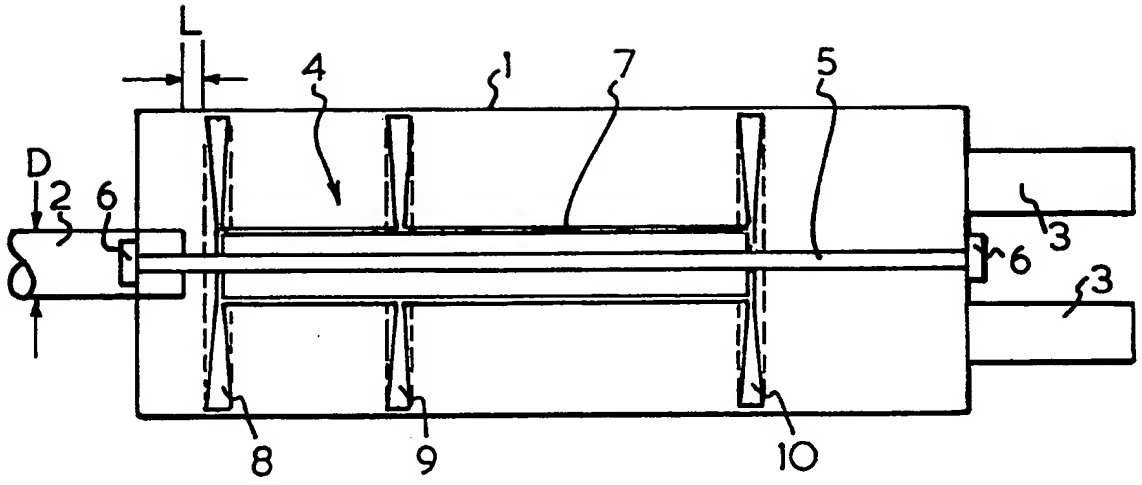

Fig 1.

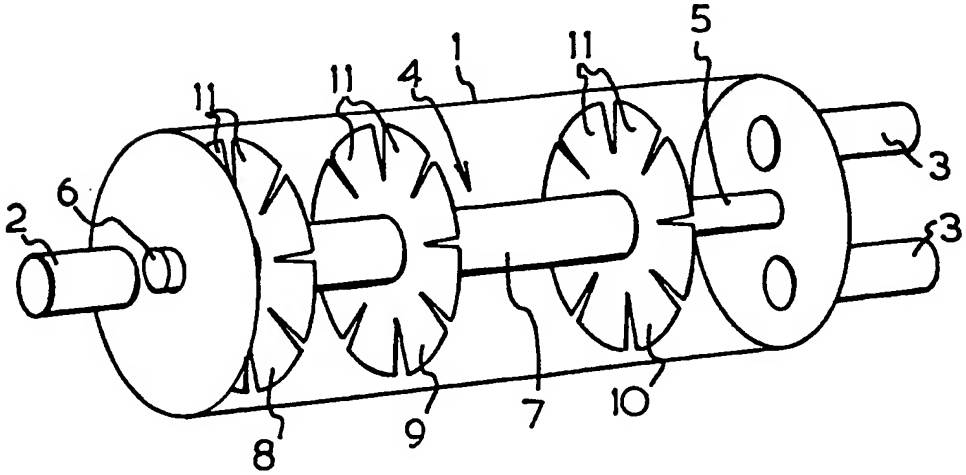

Fig 2.

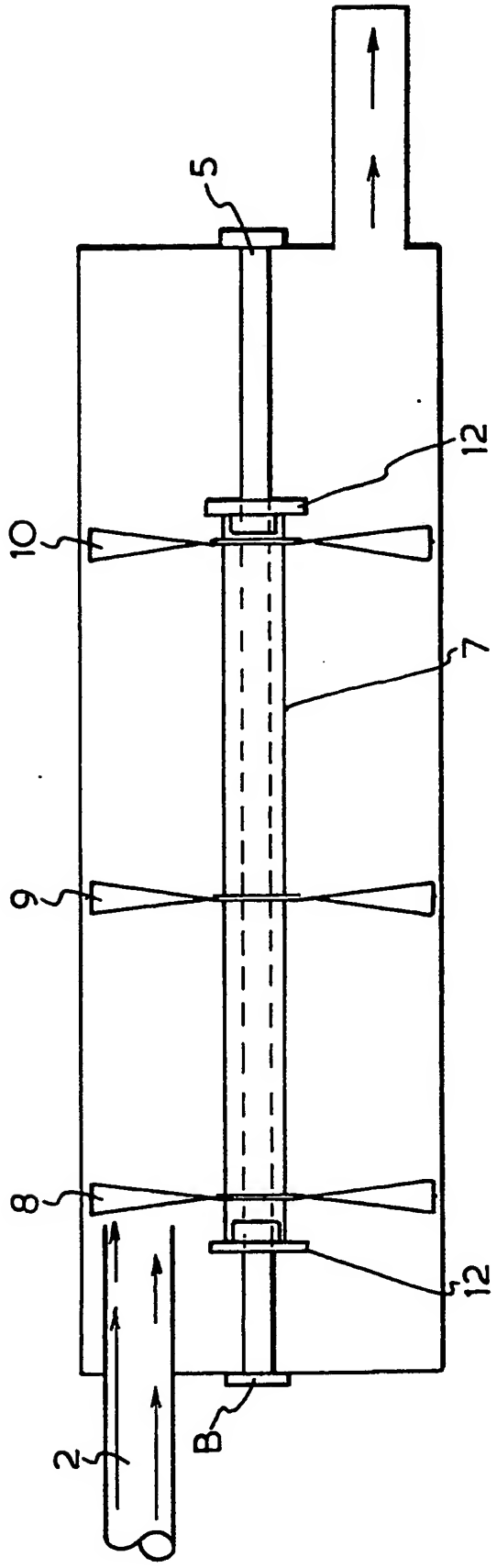

Fig 3

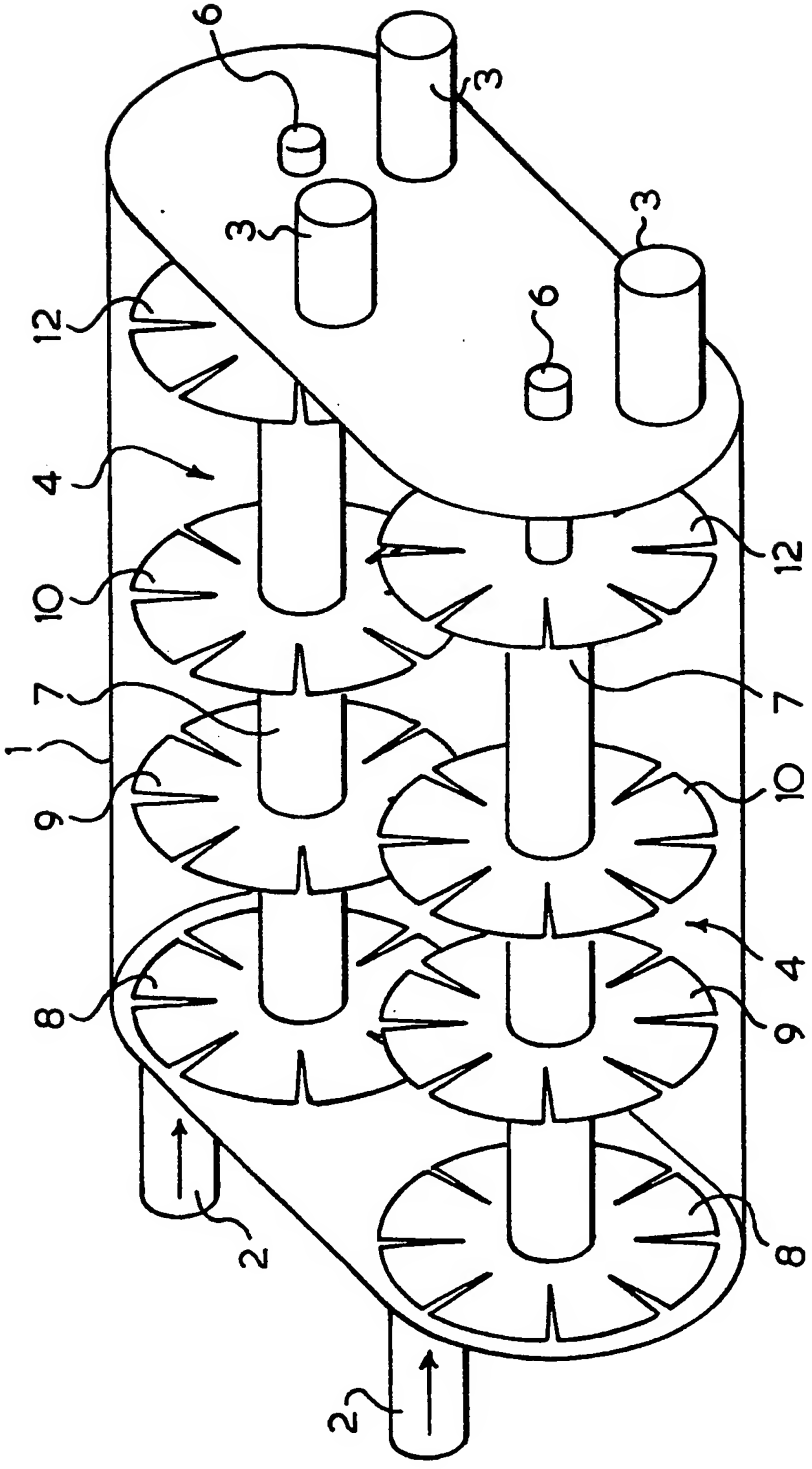

Fig 4

DESCRIPTION

EXHAUST SILENCER FOR AN INTERNAL COMBUSTION ENGINE

The present invention relates to an exhaust silencer for an internal combustion engine and more especially to an exhaust silencer for an internal combusion engine which is both of simple construction and very efficient.

Conventional exhaust silencers for internal combustion engines generally comprise an expansion chamber located in the exhaust system of the engine within which fixed baffle plates or an acoustic muffling material are provided to absorb noise. Whilst these conventional exhaust silencers significantly reduce the level of noise from the exhaust system, in doing so they also reduce the flow of exhaust gases from the engine to atmosphere. This does little to enhance to efficiency of the engine which, for obvious reasons, must effectively vent the exhaust gases from the engine to ensure a clean and efficient burn.

It is an object of the present invention to provide an exhaust silencer which obviates or at least substantially mitigates the problems associated with conventional exhaust silencers.

According to the present invention there is provided an exhaust silencer for an internal combusion engine comprising an expansion chamber having an exhaust inlet and an exhaust outlet, and within the expansion chamber at least

one fan mounted for rotation about an axis extending in the direction of the flow of the exhaust gases through the expansion chamber.

Preferably, the exhaust silencer comprises a plurality of fans mounted on a common shaft which is rotatable about said axis. The lead fan, that is to say the fan nearest the exhaust inlet, forms a silencing turbine which is rotatably driven about the said axis by the flow of exhaust gases over the blades thereof. As the silencing turbine rotates it has the effect of smoothing the flow of exhaust gases through the expansion chamber and significantly reduces noise emission from the exhaust system.

Preferably, the silencing turbine is spaced from the exhaust inlet by a distance of between 5 to 20% of the exhaust inlet diameter. This ensures that the exhaust gases impart sufficient energy to the silencing turbine to start it rotating, and gives maximum efficiency in operation. Conveniently the exhaust inlet is extended into the exhaust silencer to within the required distance of the silencing turbine.

As the silencing turbine rotates it turns the common shaft on which it and the remaining fans are mounted. These remaining fans serve as extraction fans and create a negative pressure differential within the expansion chamber which has the effect of drawing the exhaust gases from the engine, through the exhaust system, and expelling them through the exhaust outlet. As will be readily understood, this ensures a clean and efficient burn within the engine and enhances the engines performance.

A variety of techniques can be employed to rotatably support the fans in the expansion chamber. For example, the fans may be mounted directly onto the common shaft which is, itself, rotatably supported at each end in bearings secured in or to the external wall of the expansion chamber. Alternatively, the fans may be mounted on a hollow tube which is adjustably secured to the shaft. In this arrangement the position of the hollow tube on the shaft can be adjusted to vary the position of the fans within the expansion chamber and in this way the optimum position for the fans may be determined.

Conveniently, the bearings are located externally of the expansion chamber and a bearing seal gasket is provided between the bearings and the external wall of the expansion chamber to provide an airtight seal. This facilitates access to the bearings from outside the expansion chamber and allows both the bearings and the gaskets to be replaced if they become worn.

In a further alternative, the fans may be mounted on a hollow tube which is mounted for rotation about a shaft which is fixibly secured at each end in or to the wall of the expansion chamber. Preferably, a bush is provided between each end of the tubular shaft and the fixed support.

Preferably, the bearings in which the shaft is mounted, or the bushes supporting the hollow tube on the

shaft are of low friction and the fan assembly itself is of sufficient mass to ensure that it continues to rotate for a while after the engine has been switched off and the exhaust gases have ceased to drive it. This ensure that any residue of exhaust gases remaining in the exhaust system are drawn out and expelled through the exhaust outlet, thus reducing problems of condensation and corrosion.

Preferably, the shaft or tube on which the fans are mounted is of relatively small diameter so as to allow for relatively large fans to be used within the confines of the expansion chamber. This contributes to the efficiency of the exhaust silencer.

In a preferred embodiment of the present invention the exhaust silencer may comprise a plurality of fan arrangements disposed in parallel to one another within the expansion chamber. This preferred embodiment may conveniently be adapted for use with large engines.

For the reasons identified above the exhaust silencer of the present invention is particularly efficient at drawing exhaust gases from the engine. As a consequence it is desirable to provide more than one exhaust outlet from the expansion chamber to accommodate the volume of gases passing through the exhaust system.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 shows a section through the side of an exhaust silencer embodying the present invention;

Fig. 2 shows a perspective view of the exhaust silencer shown in Fig. 1 with the expansion chamber casing partially cut away;

Fig. 3 shows a section through the side of an exhaust silencer according to a second embodiment of the present invention; and

Fig. 4 shows a perspective view of an exhaust silencer according to a third embodiment of the present invention, with the expansion chamber casing partially cut away to reveal two separate fan assemblies.

Referring to Figs. 1 and 2 of the accompanying drawings there is shown an exhaust silencer, adapted in use to be fitted in the exhaust pipe of an exhaust system.

The exhaust silencer comprises an elongate, tubular outer casing 1, the interior of which defines an expansion chamber. In one end of the casing 1 there is provided an exhaust inlet 2 which is located off-centre from the central axis of the casing 1, and in the opposite end of the casing 1 there are provided two exhaust outlets 3.

Within the casing 1 and extending co-axially with the central axis thereof there is provided a turbine and extraction fan arrangement 4. This arrangement 4 consists of a supporting shaft 5 which is mounted at each end, through the casing 1, in bearings 6. Between the casing 1 and each of the bearings 6 there is provided a bearing seal gasket (not shown) which ensures an airtight seal. A hollow tube 7 is rigidly mounted on the supporting shaft 6 and supports at spaced intervals along its length three fans 8, 9 and 10. The positions of the fans 8 to 10 within the expansion chamber has a direct bearing on the efficiency of the exhaust silencer and therefore the position of the hollow tube 7 on the supporting shaft 5 can be adjusted by sliding it along its length. Ideally, the leading fan or turbine fan 8 is spaced from the outlet of the exhaust inlet 2 by a distance (L) of between 5 to 20% of the inlet exhaust diameter (D).

The leading fan 8, forms a silencing turbine, and the remaining fans 9 and 10 define extraction fans which are driven by the turbine fan 8. All three fans 8 to 10 comprise a plurality of blades 11.

In use, the exhaust silencer is mounted in the exhaust system of an internal combustion engine with the exhaust inlet 2 connected to the engine exhaust outlet. When the engine is switched on exhaust gases are expelled through the engine exhaust outlet into the expansion chamber defined by casing 1 and impinge upon the silencing turbine 8. The flow of gases over the blades 11 of the silencing turbine 8 cause it to rotate within the expansion chamber

and this has the effect of smoothing out the flow of exhaust gases through the exhaust system. As a direct consequence of this smoothing out the level of noise emitted from the exhaust system is reduced.

As the silencing turbine 8 rotates it also turns fans 9 and 10 which act as extractor fans, positively drawing exhaust gases from the engine and expelling them through the exhaust outlets 3. By reducing the volume of residual exhaust gases remaining in the engine a clean and efficient burn is achieved within the engine, which enhances the engines performance.

The bearings 6 in which the arrangement 4 is mounted are of low friction and the arrangement 4 itself is of sufficient mass to store up a deal of kinetic energy so that it continues to rotate for a while after the engine has been switched off and the exhaust gases have ceased to drive it. This ensures that any residue of exhaust gases remaining in the exhaust system are drawn out and expelled through the exhaust outlets 3, thus reducing problems of condensation and corrosion. As a direct consequence of this the working life of the exhaust silencer is considerably enhanced. However, the bearings 6 and the bearing seal gaskets may fail within this working lifetime. By mounting the bearings to the exterior of the casing 1 it is possible to replace them, simply and with the minimum of effort.

Referring now to Fig. 3 of the accompanying drawings there is shown a second embodiment of an exhaust silencer according to the present invention. This embodiment is almost identical to that of Figs. 1 and 2, except that each end of the supporting shaft 5 is fixibly secured to a respective end wall of the casing 1 and the hollow tube 7 supporting the fans 8, 9 and 10 is mounted for rotation about the fixed supporting shaft 5. A bush 12 is provided between each end of the hollow tube 7 and the supporting shaft 5 to provide a low friction point of contact between the fan assembly and the supporting shaft 5. In this embodiment the fan assembly is relatively lightweight and, therefore, less energy is required to rotate it than is the case with the embodiment of Figs. 1 and 2.

Referring now to Fig. 4 of the accompanying drawings there is shown a further embodiment of an exhaust silencer embodying the present invention. Component parts held in common with the exhaust silencer of Figs. 1 and 2 have been identified with the same reference numerals.

In Fig. 4 there is shown an exhaust silencer of greater capacity than that of the previously described embodiments, which is intended for use with engines having a dual exhaust. To this end two exhaust inlets 2 are provided in the casing 1 and two separate fan assemblies, each having a total of four fans, are provided side by side within the casing 1.

Whilst the exhaust silencers of Figs. 1 to 3 have been shown with three fans 8 to 10 mounted more fans may be used if deemed appropriate. In the end, the number of fans used will be a trade off between the required mass of the fan assembly and the volume of exhaust gases to be shifted through the exhaust system. The operation of each assembly 4 is as described with reference to Figs. 1 and 2, and therefore further explanation is not deemed to be necessary.

CLAIMS

1. An exhaust silencer for an internal combustion engine comprising an expansion chamber having an exhaust inlet and an exhaust outlet, and at least one fan mounted for rotation within the expansion chamber about an axis extending in the direction of the flow of the exhaust gases through the expansion chamber.

2. An exhaust silencer according to claim 1, comprising a plurality of fans and the fan nearest the exhaust inlet serves as a silencing turbine which is rotatably driven about the said axis by the flow of exhaust gases over the blades thereof and the remaining fans serve as extraction fans and create a negative pressure differential within the expansion chamber.

3. An exhaust silencer according to claims 1 or 2, wherein the fans are mounted on a hollow tube which is adjustably mounted on a shaft which is rotatably supported at each end in bearings secured in or to a respective end wall of the expansion chamber.

4. An exhaust silencer according to claim 3, wherein the bearings are each located externally of the expansion chamber and a bearing seal gasket is provided between the bearings and the end wall of the expansion chamber to provide an airtight seal therebetween.

5. An exhaust silencer according to claim 1 or 2, wherein the fans are mounted on a hollow tube which is mounted for rotation about a shaft which is secured at

each end in or to a respective end wall of the expansion chamber.

6. An exhaust silencer according to claim 5, wherein a bush is provided between each end of the hollow tube and the fixed shaft.

7. An exhaust silencer according to any preceding claim wherein the fan nearest the exhaust inlet is spaced from the exhaust inlet by a distance of between 5 to 20% of the exhaust inlet diameter

8. An exhaust silencer according to any preceding claim wherein the combined mass of the fan assembly is sufficiently great to ensure that it continues to rotate for a while after the engine has been switched off and the exhaust gases have ceased to drive it.

9. An exhaust silencer according to any preceding claim wherein the shaft or tube on which the fans are mounted is of relatively small diameter so as to allow for relatively large fans to be used within the confines of the expansion chamber.

10. An exhaust silencer according to any preceding claim comprising a plurality of fan arrangements disposed in parallel to one another within the expansion chamber.

11. An exhaust silencer according to claim 10, comprising a plurality of exhaust outlets from the expansion chamber.

12. An exhaust silencer substantially as hereinbefore described with reference to the accompanying drawings.

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